

Integrated Ground Operations Demonstration Units (IGODU)

Completed Technology Project (2011 - 2014)



Project Introduction

The overall goal of the AES Integrated Ground Operations Demonstration Units (IGODU) project is to demonstrate cost efficient cryogenic operations on a relevant scale that can be projected onto future Spaceport architectures and extraterrestrial surface operations. The results of this project are being incorporated and built on in the AES Autonomous Propellant Loading project.

The overall goal of the project is to demonstrate cost efficient cryogenic operations on a relevant scale that can be projected onto future Spaceport architectures and extraterrestrial surface operations. This goal will be demonstrated by completing the primary test objectives below: GODU Integrated Refrigeration and Storage (IRAS) Demonstrate zero loss storage and transfer of LH2 at a large scale. Demonstrate hydrogen densification in storage tank and loading of flight tank Demonstrate in situ hydrogen liquefaction using helium refrigeration GODU Autonomous Control of Cryogenic Propellant Load Demonstrate autonomous control of a sub-scale vehicle loading operation Demonstrate recognition of common system faults and anomalies and recover without human intervention Evaluate tools and techniques in real world application to advance health management and autonomous control technologies for future applications Demonstrate scalability and extensibility by replicating autonomous control of the 6,000 gallon LOX simulator system to the 33,000 gallon LH2 system Develop and demonstrate helium conservation instrumentation and processes Provide potential hardware-in-the-loop demonstration capability for AES Automated Mission Operations project or other analog test environment for remote operations in 2014

Anticipated Benefits

The project can realize: 1) Reduced costs due to elimination of cryogenic propellant boiloff and reduction of transportation/distribution losses, 2) Enabling practical use of densified propellant operations to increase launch vehicle performance, 3) Reduction of helium use for liquid hydrogen propellant operations (conserving a finite natural resource and reducing operations costs), 4) Reduced labor costs and increased safety during hazardous cryogenic propellant loading operations, and 5) Lower system maintenance cost by implementing automated system health management.



Project Image Integrated Ground Operations Demonstration Units (IGODU)

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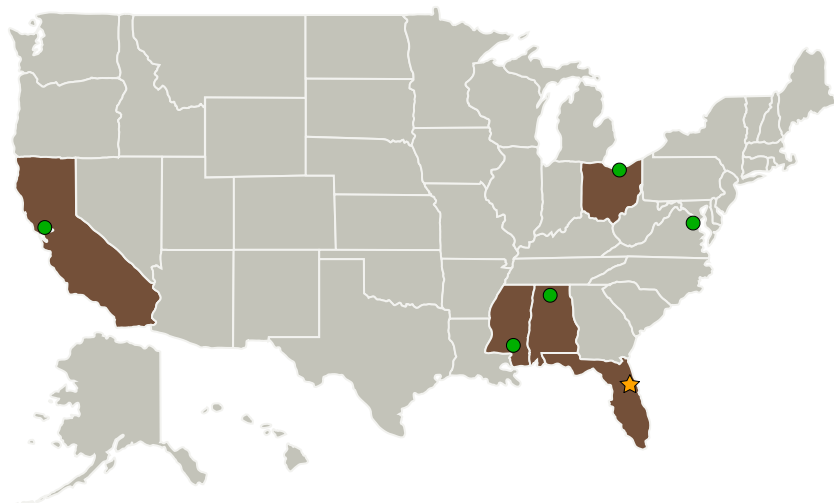
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
● NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
● Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

Christopher L Moore

Project Manager:

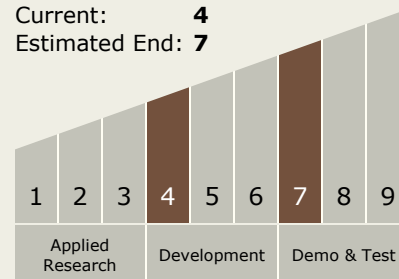
Robert G Johnson

Principal Investigator:

Robert G Johnson

Technology Maturity (TRL)

Start: 4
 Current: 4
 Estimated End: 7



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Primary U.S. Work Locations

Alabama	California
District of Columbia	Florida
Mississippi	Ohio

Project Transitions

 **October 2011:** Project Start **September 2014:** Closed out

Closeout Summary: To request closeout information for this project, please send an email with the Subject "TechPort Closeout Report Request" to hq-aes@mail.nasa.gov and specify which project closeout report you are requesting.

Images

**5108.jpg**

Project Image Integrated Ground
Operations Demonstration Units
(IGODU)

(<https://techport.nasa.gov/image/1279>)

Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.1 Infrastructure Optimization
 - └ TX13.1.4 Propellant Production, Storage and Transfer